

dorsal dots and the sides of the abdomen snow-white; antennæ with ferruginous pectinations. Wings below pale emerald-green, with an indistinct discal series of sap-green spots; primaries also with a straight postmedian stripe of the same colour; veins white; fringe sap-green tipped with white: body white, yellowish in front. Expanse of wings 2 inches 5 lines.

N.E. Himalayas (*Lidderdale*). Type B. M.

37. *Geometra grata*, sp. n.

Emerald-green; wings sparsely striated with golden orange: primaries with the costal margin pinky whitish, crossed by dark brown striæ and dots; two widely separated, inarched, subparallel golden-orange lines, the inner one distinctly irregular, the outer one very slightly so; fringe tipped with white: secondaries with the costal border, abdominal margin, and the outer half of the fringe upon the outer margin snow-white; a transverse, diffused, golden-orange stripe just before the middle: palpi, antennæ, and front of collar pinky white; abdomen creamy white, greenish at base. Under surface sericeous white, the wings showing a tint of green owing to the transparency of their texture; costal border creamy; the numerous striæ of the upper surface indistinctly visible; a curved greyish line just beyond the middle; minute blackish discocellular dots: pectus green in front. Expanse of wings 1 inch 10 lines.

Darjiling (*Lidderdale*). Type B. M.

Nearest to *G. dentisignata* of Moore.

[To be continued.]

XVI.—*Report on Specimens dredged up from the Gulf of Manaar and presented to the Liverpool Free Museum by Capt. W. H. Cawne Warren.* By H. J. CARTER, F.R.S. &c.

[Continued from p. 61.]

[Plates VII., VIII.]

Geodina.

To facilitate an understanding of the complicated spiculation of a typical *Geodia*, and thereby to save repetition in description hereafter, the following definitions are premised, viz. :—

1. The “zone-spicule.” This is generally the largest of all and trifid at its external extremity, where the arms, either

simple or subdivided, are for the most part spread out among and support a layer of siliceous balls or globules on the surface, called the "cortex" or petrous crust; while the shaft is directed perpendicularly inwards; and thus, in juxtaposition, it forms in combination around the *Geodia* a more or less distinct zone, whence its name.

2. "Body-spicule." This, which is acerate, fusiform, smooth, and curved, is generally the next in size to the zone-spicule, but by far the most numerous, as it is not only the staple spicule of the body, but, when associated with the zone-spicules, lies parallel with them, projects into the cortex, and thus adds to the strength of the zone generally, as well as the cortex.

3. "Forks" and "anchors." These are essentially anchoring-spicules, and, from the embryo upwards, are, as a matter of course, projected beyond the surface. They are trifid; but whereas in the "fork" the arms or prongs are produced, they are recurved in the "anchor," while the shaft in both, which is very long, depends for its length upon the distance the heads are beyond the *Geodia*. From their great delicacy and brittleness, they are for the most part broken off, especially the anchor-heads; their presence among the zone-spicules preparatory to their exertion is thus frequently the only evidence, of their existence; and here they appear to be for any purpose but that of "anchoring" or fixing the *Geodia*. Hence their office is often overlooked.

4. "Siliceous globule." This is developed in the interior, where it may be seen in all stages of growth till fully formed, when it appears to be transferred to the surface, where, in combination, it forms the cortex or petrous crust, in which there are no *young* forms. In its earliest stage of development, or when it is but just visible, it appears to be stelliform; the rays then become multiplied, extended, and hair-like; after which, as they grow outwards, they become united into a crystalline mass, which finally assumes a more or less compressed, spheroidal, or elliptical form; meanwhile a hilous depression becomes apparent on one side; and finally the rest of the surface is covered by little stelliform bodies in juxtaposition, which are respectively supported by the rays, now undistinguishably consolidated into a crystalline mass.

5. "Stellates." There are always two forms of stellates, both of which are very minute—but one much smaller than the other; and this is chiefly confined to the surface, where it densely charges and thus strengthens the pore-bearing dermal sarcode. The other or larger form is chiefly confined to the sarcode of the interior (for they are both flesh-spicules), where

it presents itself much less plentifully ; but, from its much larger size, the less number of its rays and their greater length, together with their irregular disposition around the centre, it is for the most part easily distinguished from the smaller ones, although they may also be, in greater or less number, present in the neighbourhood ; still it seems to me to be but an enlargement of the latter.

6. "Dermal acerate" or "acuate." In addition to the dermal stellate there is frequently a minute linear spicule on the surface, which may be acerate or acuate in form according to the species, and whose use, as it projects beyond the dermal sarcode, may be, as in other instances, through elevation and depression, to exert some influence over the functions of the pore.

Geodia perarmata, Bk. (Pl. VI. figs. 32, *a-d*,
33, *a-f*, 34, *a-c*, and 35, *a-d*.)

General form spheroidal. Colour grey. Surface uniformly wrinkled (now dry) and cribriform (Pl. VI. fig. 32). Pores minute and numerous in the dermal sarcode, giving to the surface its cribriform structure (fig. 34). Vents small, scattered singly or grouped here and there. Spicules of seven forms, viz. :—1, the zone-spicule, whose head consists of three arms, each of which is furcated, and all expanded at right angles to the shaft after the division of the arms, which at first are slightly inclined forwards, shaft 280 by 6-1800ths, head 50-1800ths in diameter (figs. 33, *a*, and 34, *a*) ; 2, body-spicule, smooth, fusiform, acerate, curved, 200 by 4-1800ths (fig. 33, *b*) ; 3 and 4, fork and anchor, arms or prongs respectively about 5-1800ths long (fig. 33, *c*) ; 5, siliceous globule, 7-1800ths in diameter (fig. 33, *d*) ; 6 and 7, external and internal stellates respectively, the former 2-6000ths and the latter 6-6000ths in diameter, the rays in both radiating from a small body or central nucleus (fig. 33, *e, f*). Zone-spicules projecting beyond the petrous crust (fig. 35, *c, d*), and so supporting the dermal sarcode charged with its stellates (fig. 35, *a*) as to leave an interval of 1-30th inch between it and the former, thus traversed by the shafts of the zone-spicules (fig. 35, *b, d*, and 32, *a-c*). Petrous crust 1-60th thick (fig. 32, *c*). The other spicules arranged as before mentioned. Size of largest specimen 1 inch in diameter.

Hab. Marine. Free or attached to hard objects.

Loc. Gulf of Manaar.

Obs. The distance between the dermal layer and the petrous crust in this species is both remarkable and instructive. It is remarkable because it is so unusual—and instructive be-

cause it points out the relation and function of this layer, which, in most specimens, is so absorbed into the petrous crust as to be undistinguishable from it; while the futility of attempting to circumscribe the uses of any thing in the Spongida is also shown by the head of the zone-spicule, generally considered to be for supporting the petrous crust, here passing beyond it so as to support alone the dermal sarcode. Of course, all that passes in through the pores must go into this subdermal interval or chamber previous to passing into the body of the sponge; moreover there are the same hourglass-shaped holes in the petrous crust as those which I so minutely described and illustrated several years ago in *Pachymatisma Johnstonia*, Bk. ('Annals,' 1869, vol. iv. p. 12, pl. ii. figs. 11, 12). It is not my object here to trace the progress of this material in through the petrous crust; but I cannot help thinking that the larger holes or vents in the dermal layer are, in all probability, the openings of the terminal canals of the excretory system, which *pass through the chamber entire*, so that their contents may not be mixed with the incoming ones through the pores.

This kind of dermal layer I described and figured many years ago in *Spongilla* under the name of "investing membrane" ('Annals,' 1857, vol. xx. p. 24, pl. i. fig. 1, *b b b*), showing that it is the seat of the dermal pores, while it is supported on the ends of spicules which, projecting from the parenchyma of the sponge, form a hollow space between it and the latter, into which the water and its contents are received before passing further into the interior. Moreover it is shown that the terminal canal of the excretory system *is* continued *through* this space or chamber *entire*, so that its contents may not mix with those of the chamber (*ib. ib.* fig. 1, *g*), which I have assumed to be the case in *Geodia perarmata*. And lately, again, I have represented it in a marine sponge, viz. *Halichondria simulans* ('Annals,' 1874, vol. xiv. pl. xxii. fig. 34, *e e*); while Dr. J. Millar has called attention to its existence over the Hexactinellida, where it is supported in a similar way, strengthened by a square lattice-work of hexagonal flesh-spicules, just as in *Geodia perarmata* it is supported on the heads of the zone-spicules and strengthened by the addition of stellate flesh-spicules.

Although these parts are not all illustrated in Dr. Bowerbank's description and illustrations of his *Geodia perarmata* (Proc. Zool. Soc. Jan. 7, 1873, p. 8, pl. ii. figs. 1 &c.), still the spiculation there given is so like that of the Manaar specimens that, taking into consideration his statement (p. 9), that the heads of the zone-spicules are "projected

through the stratum of siliceous ovaria (globules)," I think that, although the locality, being not known, may be different, there can be no doubt that the Manaar specimens are identical with it in species; and therefore I have used Dr. Bowerbank's name. The minute acerate dermal spicule to which he alludes I have not seen.

Geodia areolata, n. sp. (Pl. VI. figs. 36, *a-g*, and 37.)

General form globular. Colour now light cinnamon externally. Surface more or less regularly areolated by lines of minute echinating acerates fixed by one end in the dermal sarcod, otherwise charged with minute stellates and closely applied to the subjacent petrous crust, one of whose holes may frequently be seen in the centre of the areolar interstice (Pl. VI. fig. 37). Pores minute and numerous in the dermal sarcod, giving it a cribriform structure. Vents in groups, or scattered here and there singly. Internal structure consisting of the usual kind of spiculation distributed throughout an areolar sarcod, more confused and compact towards the centre, but presenting no defined nucleus. Spicules of eight forms, viz. :—1, the zone-spicule, with trifid head expanded at nearly right angles to the shaft, 200 by 5-1800ths, head 40-1800ths in diameter (fig. 36, *a*); 2, large, smooth, fusiform, acerate, curved, 150 by 3-1800ths (fig. 36, *b*); 3 and 4, fork and anchor, arms respectively about 5-1800ths long (fig. 36, *e*); 5, siliceous globule, 21 by 16-6000ths (fig. 36, *d*); 6 and 7, external and internal stellates respectively, the former 1-6000th and the latter 4-6000ths in diameter (fig. 36, *e, f*), in form much the same as in the last species; 8, minute dermal acerate, 60-6000ths long (fig. 36, *g*). Spicules arranged in the usual way, viz. the heads of the zone-spicules spread out in the inner part of the petrous crust, which is 1-35th inch in thickness. Size of largest specimen about an inch in diameter.

Hab. Marine. Free or attached to hard objects.

Loc. Gulf of Manaar.

Obs. This chiefly differs from the last species in the areolated form of the dermal layer, arising from the presence of reticulated lines of minute echinating acerates, its contact with the petrous crust, the form and position of the heads of the zone-spicules, and the cinnamon colour externally.

Geodia ramodigitata, n. sp. (Pl. V. fig. 31, *a-f*.)

General form cylindrical, digital, occasionally branched (Pl. V. fig. 31). Colour grey. Surface (which is much worn)

covered here and there by the remains of a cribriform dermal membrane charged with minute stellates. Pores producing the cribriform structure of the dermal layer. Vents in groups or scattered singly here and there. Internal structure the same as that last mentioned, thickening towards the axis of the cylinder. Spicules of seven forms, viz.:—1, zone-spicule, with trifid arms expanded at right angles to the shaft, which measures 160 by 4-1800ths, and head 24-1800ths in diameter (fig. 31, *a*); 2, body-spicule, acerate, curved, smooth, fusiform, 126 by 4-1800ths (fig. 31, *b*); 3 and 4, fork and anchor, arms respectively about 4-1800ths long (fig. 31, *c*); 5, siliceous globule, 10 by 8-1800ths long (fig. 31, *d*); 6 and 7, external and internal stellates respectively, the former 1-6000th and the latter 8-6000ths in diameter (fig. 31, *e* and *f*). The zone-spicules have their heads in the petrous crust, which is 1-16th inch in diameter. Size of largest specimen about 5 inches long, largest part of cylinder $\frac{1}{3}$ inch in diameter.

Hab. Marine. Free or attached.

Loc. Gulf of Manaar.

Obs. This species, besides differing from the rest in shape, has larger siliceous globules and larger internal stellates. It is more or less covered by detritus (bits of shells &c.) and small calcareous organisms, which have become attached to and grown upon it, respectively, during the time it has been carried about by currents at the bottom of the sea.

Geodia globostellifera, n. sp. (Pl. VI. fig. 38, *a-f*)

Globular. Colour grey. Surface more or less covered with detritus as in the last species. Spicules of seven forms, viz.:—1, the zone-spicule, with trifid thin arms expanded laterally at right angles to the shaft, which is 122 by $1\frac{1}{2}$ -1800ths, and head 36-1800ths in diameter (Pl. VI. fig. 38, *a*); 2, body-spicule, acerate, curved, smooth, fusiform, 170 by $1\frac{1}{2}$ -1800ths (fig. 38, *b*); 3, fork (no anchor could be found), arms 8-1800ths long (fig. 38, *c*); 4, siliceous globule, spheroidal and oval respectively, about 5-1800ths in diameter (fig. 38, *d*); 5, *globostellate*, consisting of a spherical body covered with short conical points or rays, $1\frac{1}{2}$ -1800th in diameter (fig. 38, *e* and *g*); 6 and 7, external and internal stellates respectively, the former 1-6000th and the latter 8-6000ths in diameter (fig. 38, *f* and *h*). Spicules arranged as in the foregoing, and the globostellate mixed up with the siliceous globules of the petrous crust. Size of specimen about $\frac{3}{4}$ inch in diameter.

Hab. Marine. Free or attached.

Loc. Gulf of Manaar.

Obs. The spiculation of this is very much like that of the last species, viz. *G. ramodigitata*; but the addition of the globostellate (no. 5), which is also present in an embryonic specimen of the same species, with an entire absence of pin-like spicules in both instances, whose presence would immediately claim for it a Hymedesmid origin, seems to indicate that it is produced by the *Geodia* itself, and thus distinguishes the latter from all other species that I have yet encountered. This form of globostellate, however, is so unusual in *Geodia*, and so common about the Manaar specimens with one or more Hymedesmids, of which it forms the basal layer (ex. gr. *H. stellivarians* &c.), that I can hardly suppose it would be present in *Geodia* under any other circumstances. Still, from what has been stated, and my inability to find *any traces* of a pin-like spicule in the midst of the petrous crust where these globostellates are present, I am unable to regard it otherwise than as a product of the *Geodia*, where it may be an enlarged form of the dermal stellate. Another character of this species is the great number of "fork" spicules that project through its surface, among which I have not been able to discover a single "anchor-head."

Stelletta euastrum, Sdt. (Pl. VII. fig. 41, *a-l*.)

Laminiform, thin; growing parasitically over groups of *Siliquaria anguina*, and therefore presenting no definite form. Colour greyish white (Pl. VII. fig. 41). Surface even. Pores minute in the dermal sarcode. Vents in groups or scattered singly here and there. Spicules of five forms, viz.:—1, the zone-spicule, with simple trifid head or with the arms more or less divided (that is, the prongs of the furcation more or less lengthened), the whole expanded laterally at right angles to the shaft, which is from 20 to 40 by 4-1800ths, head 27-1800ths in diameter, both shaft and head being very variable in form and size (fig. 41, *b*); 2, body-spicule, acerate, smooth, curved, fusiform, 60 by 2-1800ths (fig. 41, *c*); 3, siliceous globule, discoid, irregularly elliptical, very thin, the hilous depression hardly discernible, and the stellate ends of the radiated structure scattered thickly but *separately* over the surface, about 17 by 9-1800ths and about 3-1800ths thick (fig. 41, *d, g, k, l*); 4, acerate (flesh-spicule), curved, microspined, more or less inflated in the centre (fig. 41, *e, g, h*); 5, stellate, 2-1800ths in diameter (fig. 41, *e, g, i*). Siliceous disks gathered together in a thin layer on the surface, but the rest of the spicules mixed together apparently indiscriminately and confusedly throughout the body; the zone-spicule

in form, size, and position the most irregular of all. Size of largest specimen, of which there are several, that of the group of *Siliquaria*, about $2\frac{1}{2}$ inches in its long diameter, compressed.

Hab. Marine. Parasitic on *Siliquaria*.

Loc. Gulf of Manaar.

Obs. This species was first named by Schmidt, who obtained the specimen from Lacaze-Duthiers, who, again, got it from La Calle, on the north coast of Africa, near Algiers (Schmidt, Spong. Küste v. Algier, 1868, p. 20); no description of it, however, is given beyond the spiculation, of which I examined a mounted type specimen in the British Museum.

The disk is, *mutatis mutandis*, identical with the siliceous globule in development, structure, and location, while the imperfectly formed zone-spicule and its irregular location puts one in mind of *Pachymatisma Johnstonia* (so abundant on our coasts); still it appears to me to be more nearly allied to *Geodia* than to *Stelletta*; and therefore I have placed it, like *Pachymatisma*, among my *Geodina*. Schmidt, as above stated, has given it the generic name of "*Stelletta*," adding, by way of designation, "*euastrum*," from the large and beautiful form which some of the stellates attain in the specimen from La Calle, but which do not occur in that of the Gulf of Manaar—although they will be seen to do so in the Australian form (fig. 42, c), which I will now describe, as it gives us more of the internal structure than is to be found on the laminiform growth over the group of *Siliquaria* (fig. 41).

Stelletta euastrum, Sdt., S.W. Australian specimen, Freemantle. (Pl. VII. fig. 42, a-c.)

Ovular, now wrinkled from being dry; 3 inches long by $1\frac{1}{2}$ inch in diameter. Colour white externally—that is, the colour of the petrous crust,—pale yellow internally, which is the colour of the sarcode (Pl. VII. fig. 42). Surface even, dimpled, poriferous throughout (fig. 42, b b). Vents of different sizes scattered here and there (fig. 42, a a a). Dermal layer composed of the disks before mentioned, mixed with both forms of the flesh-spicule, about 1-360th inch thick, surrounding a pale yellow widely areolated body-structure charged with the spicules of the species and, if anywhere, less condensed in the centre than towards the circumference; thus, in the absence of any zonular arrangement and central condensation like that of a typical *Geodia*, this species is identical with *Pachymatisma Johnstonia*, Bk. Possessing much the same kind of spiculation as the Manaar specimen, it has, in addition, the large and beautiful stellate (fig. 42, c)

"*euastrum rota*," Sdt., which seems to be always quadri-radiate with rays of equal length, viz. 12-6000ths, spined over the outer half, and parting at the same angle from the centre of union, where there is no body. But this spicule is confined to the parenchymatous structure, of which there being none or very little in the Manaar specimen from its thin, parasitic, laminiform growth, may account for its absence there; while the same kind of smaller and more radiated stellates, about half the size in both specimens, are equally abundant, in the dermal layer especially.

Besides *Stelletta euastrum* there are two other species with discoid siliceous globules in the Adriatic, which Schmidt has named respectively *S. discophora* and *S. mamillaris* (Spong. Adriat. Meeres, 1862, pp. 47, 48, Taf. iv. fig. 5, and Taf. v. fig. 1, respectively), of which there is a specimen (for they both appear to me to be the same species) in the British Museum, obtained by Mr. Saville Kent from the coast of Portugal; and from this, together with Schmidt's illustrations, it is evident that the same kind of discophorous layer on the surface, the absence of the zonular arrangement of the spiculation and that of the "forks and anchors," so characteristic of *Geodia*, exists in all, with a badly-developed condition of the zone-spicule (which, as above stated, varies in the form of its head from trifid to trifurcate, and in that of its shaft from long to short, pointed and obtuse), scattered here and there amongst the rest of the spicules without any apparent regularity whatever. In short, the structure is as different from that of a *Geodia* as it is specifically characteristic of *Pachymatisma Johnstonia* and *Caminus vulcan*, Sdt. (*op. et loc. cit.*). All of these, therefore, although belonging to the Geodina, should constitute a different group from *Geodia* proper.

Stellettina.

The chief difference between the Stellettina and Geodina is the total absence of the "siliceous globule" in the former, whether spheroid or discoid, leaving nothing but the "dermal stellates" to rest upon the zone-spicules &c., which are for the most part similarly arranged to those of *Geodia*, although seldom with such characteristic regularity.

Stelletta tethyopsis, n. sp.
(Pl. VI. fig. 39 and 40 a-f.)

General form subhemispherical and sessile, or spheroidal and free (Pl. VI. fig. 39). Colour grey. Surface uniformly hispid from the projection of the forks and anchors, beneath

which may be seen the heads of the zone-spicules supporting the dermal sarcode charged with its stellates. Pores in the dermal layer. Vents not seen, probably owing to contraction and dryness. Internal structure very compact on account of all the spicules lying close and nearly parallel to each other as they uninterruptedly converge from the circumference to a point in the centre, where there is no nucleus (fig. 39). Spicules of five forms, viz.:—1, the zone-spicule, consisting of an extremely long, smooth, slightly curved shaft and trifid head trifurcated, of which the three arms advance obliquely forwards at an angle of 45° with the shaft, and the rest turn off at right angles to it, shaft 625 by 5-1800ths, head about 30-1800ths in diameter (fig. 40, *a a*); 2, body-spicule, also extremely long, acerate, smooth, slightly curved fusiform, 625 by 4-1800ths (fig. 40, *b b*); 3, forks and anchors largely developed, of which the arms respectively are about 10-1800ths long (fig. 40, *c*); 4 and 5, external and internal stellates, the former about 1- and the latter 4-6000ths in diameter (fig. 40, *e, f*), both multiradiate and without central nucleus or body—that is, their rays radiate from a central point which is not differentiated,—the internal stellate, as is usual in *Stelletta*, very faintly developed, and the rays fewer and longer than those of the external one. Largest specimen sessile, about two inches in horizontal diameter at the base and $\frac{3}{4}$ inch high, somewhat umbonate; but a considerable portion appears to have been left on the rock where it grew.

Hab. Marine. Free or fixed.

Loc. Gulf of Manaar.

Obs. This is a very beautiful species, from the compactness and regularity of its structure internally, which also causes it to closely resemble *Tethya cranium* (the type of my Tethyina), hence its designation; but its spiculation is that of a *Stelletta*. The head of the zone-spicule is subject to great variety in form, sometimes assuming that of the "fork" greatly enlarged (fig. 40, *d*). It is stated above that a considerable part of the base was probably left on the rock where it grew, since I know by experience, on the S.E. coast of Arabia, that a sponge possessing this kind of structure contracts so forcibly when alive and fixed on the rock where it may be growing, that it can only be got off in portions with hammer and chisel!

Tisiphonia nana, n. sp. (Pl. VII. fig. 43, *a-e*.)

Laminiform, thin, or filling up the depression in the Melobesian nodule where it may be growing. Colour white. Surface even. Spicules of four forms, viz.:—1, large trifur-

cate with very short conical shaft, 6 by 3-1800ths, head 50-1800ths in diameter (Pl. VII. fig. 43, *a, b*); 2, acerate, smooth, fusiform, curved, 27 by 1-1800ths (fig. 43, *c*); 3, acerate flesh-spicule, smooth, fusiform, curved, inflated in the centre, 4-1800ths long (fig. 43, *d, e*); 4, stellate flesh-spicule 4-6-rayed, rays microspined, 3-6000ths (fig. 43, *d, e*). The large trifurcate spicule is parquettied in amongst the rest so as to form a smooth even surface over an areolar structure, whose thickness varies with the subjacent depressions of the Melobesian nodule over which the sponge is growing. Size about one third of an inch in horizontal diameter.

Hab. Marine. On hard objects.

Loc. Gulf of Manaar.

Obs. Dwarfed as this variety is, one can see by its spiculation, although modified by its habitat on the surface of the Melobesian nodule, that it belongs to the *Stelletina*. The trifurcate head, although necessarily with an extremely short shaft, indeed hardly more than a short cone (fig. 43, *b*), and the acerate spicule no. 2, are equivalent to the zone- and body-spicule in *Geodia* respectively; while the central inflation of the acerate flesh-spicule, although not microspined, and the tendency in the stellate to assume a spinispirulate form, ally it to the *Tethea muricata* of Bowerbank, the synonymy of which I have already published ('Annals,' 1878, vol. ii. p. 174); but I find that, in this article, I have omitted to mention that my dear old friend, Dr. J. E. Gray, in a note to me, dated 3rd January, 1871, foreshadowed what I have therein chiefly stated, viz. that "Bowerbank's figures of the spicules of his *Tethea muricata* (B. S. vol. i. figs. 304, 305) are probably those of *Tisiphonia*, *Wyvillethomsonia* and *Dorvillia* respectively," which is now proved to be the case by Dr. Bowerbank's own words and his illustrated description of *Tethea muricata* (Proc. Zool. Soc. 1872, p. 115, pl. v. figs. 1-6).

The first mention of the name *Tisiphonia* for a sponge occurs in Sir Wyville Thomson's paper on *Holtenia Carpenteri* (Phil. Trans. vol. 159, p. 712), read before the Royal Society on the "17th June, 1869," where, without more than the letters "n. g." after it, he gives it as one of the genera illustrating his "suborder Leptophlea." Subsequently we have the name "*Wyvillethomsonia*" proposed as a generic appellation for the same species by Dr. P. Wright in January 1870; and then comes Schmidt's of "*Stelletta*" in the month of May following, ending with that of "*Dorvillia*" by Mr. Saville Kent in Dec. 1870.

Now it is evident that no one but Dr. Gray had seen that

this was a form of Dr. Bowerbank's *Tethea muricata* up to the date above mentioned; or if so, no one ever noticed it publicly. Still it is equally evident that *Tisiphonia*=*Dorvillia* is sufficiently different from *Tethea muricata* to require specific distinction; at the same time that *Tethea muricata* is not a species of *Tethea*, but one of *Stelletta*, as Schmidt has made it from his examination of the Florida specimen.

Furthermore, we find Dr. Bowerbank multiplying the varieties of this sponge under the names *Ecionemia compressa*, *Hymeniacidon placentula*, and *Normania crassa* respectively (B. S. 1874, vol. iii.), all of which specimens (now in the British Museum) I have had the opportunity of examining. Hence, when we find the species (varieties) of a sponge so numerous, it becomes necessary to make a group of them under a specific name; and as Sir Wyville Thomson's use of "*Tisiphonia*" claims priority in this respect, I have applied it generically to the species above described, and shall apply it *provisionally* to the two following ones, merely observing that, while I consider them all varieties, the human mind can never remember them without specific distinction. Nature does not require this aid.

Tisiphonia annulata, n. sp. (provisional).
(Pl. V. fig. 28, *a-d*.)

Massive, charged with the spicules of the species, without apparent regularity. Colour white. Spicules of three forms, viz.:—1, quadriradiate, arms equal in size, radiating at equal angles from a common centre, annulated throughout with alternate inflations and depressions, the former microspined and sometimes broken or incomplete in the annulation, arm 17 by $1\frac{1}{2}$ -1800ths (Pl. V. fig. 28, *a* and *d*); 2, acerate, smooth, fusiform, curved, 63 by $1\frac{1}{2}$ -1800ths (fig. 28, *b*); 3, spinispirulate flesh-spicule, 3-6000ths long (fig. 28, *c*). Spicules arranged confusedly in an areolated sarcode; nos. 1 and 3 in great abundance and of various sizes, the former below and the latter above their stated measurements respectively. Size of specimen about 1-12th inch in diameter.

Hab. Marine. Growing on hard objects, in the present instance among the minute detritus attached to the specimen of *Stelletta euastrum* (Pl. VII. fig. 42).

Loc. Gulf of Manaar.

Obs. This sponge was found growing in the place just mentioned. The facies of the spiculation appears to me to be that of a variety of *Tisiphonia*; and if so, the quadriradiate spicule is, with the exception of the annulation, like that given by Dr. Bowerbank of *Normania crassa* (B. S. vol. iii. pl. lxxxi.

fig. 5) ; but the characteristic acerate flesh-spicule (viz. microspined and centrally inflated) is absent, although the spinispirula is not, but abundantly present.

The chief interest, however, of this specimen is in the annulated quadriradiate form, on account of its resemblance to the fossil spicule from the Upper Greensand of Haldon Hill, near Exeter, which I represented in 1874 ('Annals,' vol. vii. pl. ix. figs. 44, 45), as it may not only throw some light on the nature of the sponge which bore this, but also on the other moniliform spicules so common in the cavities of the chalk-flints of Oxfordshire and perhaps elsewhere, but first represented from some Irish specimens by Mr. Joseph Wright, F.G.S., in the Belfast Nat. Hist. Field-Club Report for 1873-74 (pl. ii. figs. 4, 5).

Tisiphonia penetrans, n. sp. (provisional).
(Pl. VII. fig. 44, *a-d*.)

Amorphous, taking the form of the excavation of the Melobesian nodule in which it may be growing. Colour white. Spicules of three forms, viz. :—1, acerate, curved, smooth, fusiform, 27 by 1-1800ths (Pl. VII. fig. 44, *a*) ; 2, the same form, but much smaller, 6-1800ths long (fig. 44, *b*) ; 3, stellate flesh-spicule, variable in the number and position of its rays, often quadriradiate, rays microspined, 4-6000ths in diameter (fig. 44, *c, d*). Size varying with that of the excavated cavity in which it may be growing.

Hab. Marine. In excavations previously made by lithodomous sponges.

Loc. Gulf of Manaar.

Obs. There is still less in this to identify directly with the spiculation of *Tisiphonia* than in the foregoing species ; but the *facies* here also strikes me as being allied to this genus. Although found in the excavated cavities of the Melobesian nodule, I doubt if it made the cavities itself ; for they often contain a heterogeneous mixture of different forms of spicules which come from as many different kinds of sponges that in my examinations I have never met with, some of which are extremely beautiful and not less remarkable, *ex. gr.* figs. 29, 30 (Pl. V.). They are generally, too, enclosed in a transparent membranous investment, which must be the remains of the living organism that not only gathered them together and enclosed them, but dragged them into some of the minutest channels of the excavation in the nodule. What was the nature of that organism, Foraminiferal or Spongioid, future observation may determine.

Lithistina.

In describing the Lithistids it is absolutely necessary to have specimens which possess the last-formed dermal layers in addition to a portion of the fully formed internal structure, because these are the parts which are most characteristic of the species; hence, although we may not possess the fully developed *entire* form, the thinnest layer, provided it contains the parts mentioned, will be sufficient to determine the species; for these will ever be the same, although the adult form of the sponge itself may be different. So that, while the specimens on the Melobesian nodules of the Gulf of Manaar are so small that, comparatively, they hardly amount to much more than traces of structure which may attain a large and definite form in the deeper sea, still, so far as they go, they will enable us to predict what they may attain in that situation.

For the most part, they have grown over the layers of *Melobesia* from which the nodules have been chiefly formed, while in many instances they themselves have been overgrown by one of the Microcionina that have been described; but, whether overgrown or not, as the spiculation of a Lithistid, for the most part, is so locked together that even boiling in pure nitric acid does not separate its parts, so in this way it has been easy to free the Lithistid not only from the calcareous *Melobesia* on which it rests, but from the *Microcionia* covering it, to such an extent as to cause it to come out under this treatment in a clean, perfect, and beautiful form. I have stated "for the most part," because it may be easily conceived that the elements of which a Lithistid is composed are not inextricably locked together until they have undergone a certain amount of development, and therefore, being more or less united by sarcode until this occurs, they are, up to this time, *separable* by boiling in nitric acid. Such is more particularly the case with the Lithistids whose structure commences in disks (viz. the *Discodermiæ*), which disks we shall hereafter find to be gradually transformed into their branched and complicated spiculation. But even here, under the boiling in nitric acid, all the separated parts can be easily retained, and, when mounted in Canada balsam, present, when *thus separate*, a much better view of their gradationary development than when *in situ*, where they lie more or less obscured in layers one over another as they are formed. The term "interlock" is here used advisedly; for whereas in the vitreous Hexactinellida the spicules are cemented together by the addition of glassy fibre, no such thing occurs in the Lithistida, whose spicules are united by *mere apposition* of the expanded ends of their filigreed branches (Pl. VIII.

fig. 51, *i*), or by an *interlocking, inseparable* without fracture, of the filigree of one branch with that of another (Pl. VIII. fig. 48, *k k k* and *l*). At least I have not yet seen *direct union* between the parts of one spicule with those of another in a Lithistid.

Although most of these Melobesian nodules present one or more growths of Lithistida upon them respectively, yet it is only in one or two instances out of the seven species that I have found that two different ones have been observed on the same nodule; while so abundant are they that it is hardly possible to mount a fragment of any other sponge on the nodule without finding in it spicules of a Lithistid.

Of the "seven species" three may be termed "*Corallistes*," because they do not appear to commence their growth in discoid elements; while the opposite is the case with the other four, which will be termed "*Discodermia*." Of course, in describing and illustrating them, my observations will be confined to their structure, since they must be regarded as only little growths or traces, as before stated, of the entire sponges; while the illustrations, on the other hand, must be considered as diagrams after nature, for such is the intricacy of Lithistid structure that it is almost hopeless to attempt any thing beyond catching the specific character and representing this as near to nature as possible. Having premised these remarks, we will begin with the *Corallistes*.

CORALLISTES.

Corallistes aculeata, n. sp. (Pl. VII. fig. 45, *a, b*.)

Surface characterized by the presence of erect spike-like processes (Pl. VII. fig. 45), which, when the structure is torn to pieces, are respectively found to be supported on three arms, which are tubercled and repeatedly subdivided into branches until they end in a filigree consisting of minute *angular* processes, which interlock with those of the neighbouring spicules (fig. 45, *a*). Spike conical, elongated, sub-sinuous, 1-333rd long by 1-120th inch in diameter at the base, more or less cononodose, tubercles more or less in circular lines round the lower two thirds of the spike (fig. 45, *a, b*). Internal structure composed of spicules of the usual Lithistid form, consisting of four arms, each of which is repeatedly divided and subdivided into branches until they end in the way above mentioned. Size of largest specimen about $\frac{1}{4}$ inch in horizontal diameter.

Hab. Marine. On hard objects.

Loc. Gulf of Manaar.

Obs. The spike supported on three arms diadem-like and uniformly distributed over the surface is the characteristic feature of this species. There is a small specimen of it in the British Museum, about 6-12ths inch in diameter, which came from the neighbourhood of Kendrick Island, south of Japan (lat. $24^{\circ} 13' N.$, and long. $136^{\circ} 13' E.$), presented by Dr. J. Gwyn Jeffreys.

Corallistes verrucosa, n. sp.
(Pl. VII. fig. 46, *a*, *b*.)

Surface characterized by the presence of short, tuberosc cones (Pl. VII. fig. 46), which, when the structure is torn to pieces, are respectively found to be supported on three arms tubercled and repeatedly subdivided into branches until they end in a filigree consisting of minute *angular* processes which interlock with those of the neighbouring spicules (fig. 46, *a*). Cone consisting of a pyramidal heap of tubercles about 1-666th inch high and 1-750th inch in diameter at the base (fig. 46, *a*), which is triangular and, for the most part, composed of three tubercles larger than the rest, triangularly placed and situated respectively opposite the *reentering* angles between the arms (fig. 46, *b*). Internal structure composed of spicules of the usual lithistid form consisting of four arms, each of which is repeatedly divided and subdivided into branches until they end like the one above mentioned. Size of specimen about $\frac{1}{4}$ inch in horizontal diameter.

Hab. Marine. On hard objects.

Loc. Gulf of Manaar.

Obs. There is nothing particular about this species beyond the form of the surface-processes, which, at the same time that they present a distinguishing feature, afford the only remarkable difference between it and *C. aculeata*.

Corallistes elegantissima, n. sp.
(Pl. VII. fig. 47.)

The spicules of this species (if it is a distinct one) were only found in microscopic groups in two places on the same nodule as *Discodermia papillata* (which will presently be described), where they were chiefly in the midst of, and thus protected by, the acerate spicules of a species of *Reniera* that had overgrown them. To describe a Lithistid spicule where there is no particular character is, from its intricateness, almost impossible; therefore I must refer the reader to the illustration, which is a careful drawing to measurement of one of these elegantly beautiful objects, merely adding that

the terminations are not round like those of most *Discodermiæ*, but pointed, prong-like, and angular, as they are delineated (Pl. VII. fig. 47).

· Discodermida.

Finding that the Discodermida grow by the transformation of a simple disk on the surface to the complicated structure of the interior, I have endeavoured to illustrate this in a series of figures which are taken from a portion that was boiled to pieces in nitric acid and the residue mounted in Canada balsam (Pl. VIII. fig. 48, *d*, &c.). Indeed all the species have been studied in this way, when the gradationary forms of the disk thus separated render it very easy, as before stated, to see and follow the changes of form which it undergoes; besides which, this may be corroborated by looking at the specimen *in situ* in its natural state through a microscope (Pl. VIII. fig. 48, *a*, *b*, *c*). In addition to the disks the Discodermida appear to be always characterized by one or more forms of minute flesh-spicules in great abundance, of which a curved acerate, or straight bacillar one, microspined, is perhaps the most prevalent (fig. 48, *h*, and 49, *c*, *d*); but these are not confined to the dermal sarcode in which the disks are developed and imbedded, although apparently most abundant there (fig. 48, *a*, &c.), but almost as plentifully distributed throughout the whole structure. Again, the filigreed ends of the branches of the full-formed spicule are *not angular*, but *more or less spherical*, like bunches of grapes interlocked with one another, after the manner of the clasping of hands (fig. 48, *l*). At the same time, however, I am not able to explain the fact that in *Kaliapsis cidaris*, Bk. (Proc. Zool. Soc. 1869, pl. xxv. fig. 2, &c.), of which I possess some good specimens *in situ*, and which is a genuine *Discodermia*, a "diadem-like" form of spicule similar in this respect to that of *Corallistes aculeata*, exists under the discophorous layer. I do not pretend to follow this transformation of the disk, which is succeeded, as usual, by the fully formed Lithistid spicule of the interior, but now only to announce the circumstance. In specimens of *Corallistes aculeata*, *in situ*, the spikes may be seen without any disks whatever, even when the surface is overgrown and thus protected by a *Microciona*; nor in the mounted residue after boiling in nitric acid of specimens of this species is there a trace of a disk under any kind of form to be observed; while in most specimens of *Discodermiæ* the *Microciona* grows upon the disks themselves.

In describing the structure of the different species of Discodermida, I shall commence with the disks, as these are the

first-formed parts, and follow the structure on by description and illustration to the full development of the spicule, finally giving a magnified view of the form of the filigreed termination characteristic of each species.

Discodermia papillata, n. sp.
(Pl. VIII. fig. 48, *a-l*.)

Surface even, discophorous, disks horizontal; structure papillated throughout, accompanied by a bacillar microspined flesh-spicule (Pl. VIII. fig. 48, *a, b, c*). Colour yellow internally. Outer layer of last-formed disks more or less circular, micropapillated in the upper, and bearing the rudiment of a spine (the shaft) in the centre of the lower surface, the smallest disk observed being circular, and about 1-300th inch in diameter (fig. 48, *b* and *d*); the next layer larger and more indented on the margin; after this the disk becomes branched, the spine or shaft fully formed (fig. 48, *e*), and the papillæ enlarged and extended over the branches (fig. 48, *f*); finally the staple spicule of the interior is produced (fig. 48, *i*), where the shaft may be observed to be trifidly divided and subdivided until it ends in the filigree, with which it interlocks with its neighbours (fig. 48, *k k k*) on all sides by botryoidal or grape-like terminations (fig. 48, *l*)—the original papillæ, now still more enlarged and extended over the shaft and branches, presenting over the former a wart-like appearance (fig. 48, *i*), probably influencing this character of the development throughout,—a similar development taking place at the inner end of the shaft, by which, both on the outer and inner side, the filigree is interlocked with corresponding portions of similar spicules; and thus the structure presents internally an increase of bulk by successive layers, as the breaking-up of a piece of fully-formed Lithistid testifies. Papillæ at first microscopic, finally becoming conical (fig. 48, *g*). Bacillar spicule elliptical, elongated, microspined throughout, about 3-6000ths long (fig. 48, *h*). Largest specimen about an inch in horizontal diameter, filling up the depressions of the Melobesian nodule over which it grows, and extending into the crevices and cavities made by excavating sponges that may be underneath.

Hab. Marine. On hard objects.

Loc. Gulf of Manaar.

Obs. I have thus summarily described the development of this discodermid sponge, so that it will not be necessary to repeat it in the other species more than the occasion demands; at the same time it should be remembered that the varieties in the structure of the elementary parts of a Lithistid are practi-

cally unlimited. Again, it frequently happens that the discophorous layer has disappeared from some cause or other, and that the surface is *then* formed by that condition of development where the disk has passed into a branched state, in which the branches, curving over each other, leave interspaces charged with the bacillar flesh-spicule (Pl. VIII. fig. 48, *a*, and 50 *a*, &c), which causes it to assume the appearance given by Dr. Bowerbank of his *Dactylocalyx Prattii* (Proc. Zool. Soc. 1869, pl. v. figs. 6-11), and the same in *Theonella Swinhoei*, Gray (*ib.* 1868, p. 565), both of which specimens, now in the British Museum, I have examined and find the *discophorous layer absent*. Nor is this to be wondered at, from what I have stated of the instability of this layer until the disks have become transformed into the interlocking spicules; still there are no papillæ on the spicules of *Dactylocalyx Prattii* or of *Theonella Swinhoei*, which distinguishes them from *Discodermia papillata*; but although the flesh-spicule is elliptical elongate in *Dactylocalyx Prattii*, and bent in the middle in *Theonella Swinhoei*, this is not sufficient for specific distinction between them; nor is the flesh-spicule generally to be depended on in this respect; so, with this difference only, I think, as Dr. Bowerbank has concluded (*op. et l. cit.*), that *Dactylocalyx Prattii* and *Theonella Swinhoei* must be considered the same species. Yet there is a large, vase-like specimen to which I have before alluded, and which comes from the seas about the Philippine Islands, in which the flesh-spicules (for there are two forms) may be considered of some specific value, since here the usual acerate curved microspined and centrally inflated flesh-spicule is accompanied by another equally plentiful, viz. a short thick ellipsoidal form also microspined, not unlike the same kind of flesh-spicule in *Pachastrella abyssi*, Sdt.

Discodermia aspera, n. sp.
(Pl. VIII. fig. 49, *a-i*.)

Surface even, discophorous, disks horizontal (Pl. VIII. fig. 49, *a, b*). Structure asperous, spinous, accompanied by an acerate microspined flesh-spicule (Pl. VIII. fig. 49, *a, b*). Colour grey. Discophorous structure and transformation much the same as in the last-described species, only that the margin of the disk soon becomes denticulated (fig. 49, *c*), and the papillæ pass into spines, as indicated by the four gradationary diagrams (fig. 49, *g*); and in the transformed disk (fig. 49, *f*) the irregularly lobed and denticulated margin, together with the spines on the surface, give that asperous appearance which more or less influ-

ences the subsequent development of the fully formed spicules of this Lithistid even to the end (fig. 49, *h*), in which the filigreed terminations are not grape-like as in the foregoing species, but subangular (fig. 49, *i*). Papillæ at first microscopic, then enlarged, after which they become united by intervening straight linear ridges, then elevated and compressed, and finally divided into spine-like processes (fig. 49, *g*), which more or less characterize the fully formed spicules (fig. 49, *h*). Flesh-spicule acerate, curved, microspined, about 5-6000ths long (fig. 49, *e*), plentifully distributed over the disks (fig. 49, *a*) and throughout the structure. Size about 1 inch in horizontal diameter, filling up the depressions on one side of a Melobesian nodule about this size.

Hab. Marine. On hard objects.

Loc. Gulf of Manaar.

Obs. The asperous character of the spiculation of this species, arising from a transformation of the original papillæ of the disk into spinous processes, as above mentioned and illustrated (fig. 49, *g*, &c.), chiefly distinguishes it. As the specimen for the most part is very much worn, I should, but for the boiling in nitric acid of a portion which had been protected by having been overgrown by a *Reniera*, have been entirely ignorant of its discophorous character and the peculiar spinous transformation of the papillæ of the disks to which I have alluded, which seems to continue its influence on to the fully formed structure.

Discodermia spinispirulifera, n. sp.

(Pl. VIII. fig. 50, *a-h*.)

Surface even, discophorous; disks horizontal; structure loose, accompanied by *two* forms of flesh-spicule, viz. an acerate and a spinispirula (Pl. VIII. fig. 50, *a, b, c*, and *e, f*). Colour white. Discophorous structure and transformation much the same as in the foregoing species, only that, instead of papillæ, the disk presents *faint* circular concentric lines (fig. 50, *d*), and, previously to passing into the branched form, show an irregularly lacerated margin in which the foreshadowed divisions of the full-formed spicule assume the most whimsical proportions and appearances (fig. 50, *i*), finally producing a branched spicule repeatedly subdivided as before until the ends become filigreed into subglobular processes (fig. 50, *g*). Flesh-spicule of two forms, viz.:—1, comparatively large, acerate, curved fusiform, microspined, about 20-6000ths inch long (fig. 50, *e*); and the other, 2, a minute spinispirula, consisting of a sinuous shaft covered with thin spines about the same length as itself, arranged over it in an echinating, spiral

manner, 3-6000ths of an inch long (fig. 50, *f*),—the former plentifully distributed over the disks, as before mentioned, and but little less so throughout the rest of the structure, while the latter sparsely accompanies it. Size of largest specimen about $\frac{1}{4}$ inch in horizontal diameter, and the thickness of the depression on the nodule where it may have grown, often extending into the cavities formed by excavating sponges.

Hab. Marine. On hard objects.

Loc. Gulf of Manaar.

Obs. The remarkably shreddy character of the advanced form of disk (fig. 50, *i*) and the presence of the spinispirular flesh-spicule, together with the comparatively large size of its companion the acerate flesh-spicule, distinctly separate this from the other species of *Discodermia*. It may be remembered that the flesh-spicule of *Dactylocalyx Masoni*, Bk., is a spinispirula (Proc. Zool. Soc. 1869, pl. vi. fig. 4).

Discodermia levidiscus, n. sp.

(Pl. VIII. fig. 51, *a-i*.)

Surface even, discophorous, disks horizontal, structure areolar, accompanied by an acerate flesh-spicule (Pl. VIII. fig. 51). Colour yellow internally. The disks here, which also present a great number of faint lines, like those of the foregoing species, are depressed in the centre (fig. 51, *b, c*). They undergo similar transformation to those of the foregoing species (fig. 51, *e*), passing at last into the fully formed spicule of the interior (fig. 51, *h h*), whose terminations appear to be more in expanded, irregular surfaces, for the sake of union by apposition with their neighbours, than in filigree processes interlocking (fig. 51, *i*). Flesh-spicule acerate, curved, fusiform, microspined, about 8-6000ths long (fig. 51, *f, g*), plentifully distributed over the disks (fig. 51, *a*) and throughout the interior, as in the foregoing species. Size of specimen about $\frac{1}{4}$ inch in horizontal diameter.

Hab. Marine. On hard objects.

Loc. Gulf of Manaar.

Obs. When viewed *in situ* (fig. 51) the depressions in the centres of the disks, which are rather less in diameter than those of the other species, together with the concentric lines, added to the comparative absence of filigree terminations in the fully formed spicule, and the yellow colour of the interior, are sufficient to distinguish it from the other species; while the absence of papillæ on the disks causes it to

differ from *D. papillata* and *D. aspera*; the absence of the shred-like transformation of the disk (although in both instances there are no papillæ on it), together with the presence of the spinispirular flesh-spicule, causes it to differ equally from *D. spinispirulifera*.

The following is a list of organisms in and about the Melobesian nodules from the Gulf of Manaar above mentioned:—

ALGÆ (calcareous).

Melobesia (?) polymorpha, lamini- form.	Melobesia, quadrangular-celled, laminiform, ? sp.
— polymorpha, nulliporiform.	Flabellaria opuntia.

FORAMINIFERA.

Sessile.

Polytrema miniaceum.	Carpenteria monticularis.
— cylindricum.	Gypsina melobesioides.
— mesentericum, n. sp. <i>Loc.</i>	— vesicularis.
unknown, not Gulf of Manaar.	— —, var. spheroidalis.
Carpenteria utricularis.	

Subsessile.

Rotalia spiculotesta.	Orbitolites marginalis.
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Free.

Calcarina calcar, var. hispida, n. var.	Cysteodictyina compressa, nov. gen. et sp.
Alveolina sinuosa, n. sp.	Ceratestina globularis, nov. gen. et sp.
Amphistegina.	— tessellata, n. sp.
Holocladina pustulifera, nov. gen. et sp.	

SPONGIDA.

Ord. ii. CERATINA.

Aplysina purpurea, n. sp.	Aplysina fusca, n. sp.
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Ord. iii. PSAMMONEMATA.

Hircinia arundinacea, n. sp.	Hircinia fusca, n. sp.
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Ord. iv. RHAPHIDONEMATA.

Chalina ? sp. (young).	Desmacidon Jeffreysii, Bk.
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Ord. v. ECHINONEMATA.

Pluriformia.

Dictyocylindrus manaarensis, n. sp.	Dictyocylindrus sessilis, n. sp.
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Microcionina.

- | | |
|-------------------------------------|---------------------------------------|
| Microciona atosanguinea, <i>Bk.</i> | Microciona curvispiculifera, n. sp. |
| — armata, <i>Bk.</i> | Hymerhaphia vermiculata, var. erecta. |
| — affinis, n. sp. | — unispiculum, n. sp. |
| — bulboretorta, n. sp. | — clavata, n. sp. |
| — quadriradiata, n. sp. | — eruca, n. sp. |
| — fascispiculifera, n. sp. | |

Baculifera.

Caulospongia, *Kent*, ? sp.

Ord. vi. HOLORHAPHIDOTA.

Thalyosa.

Reniera ? sp. Brown and white.

Crassa.

Reniera ? sp. Yellow and yellowish grey.	Reniera ? sp. White.
	— ? sp. Dark brown.

Fibulifera.

Reniera fibulifera, *Schmidt*.

Halichondrina.

Halichondria aceratospiculum, n. sp.	Halichondria albescens, <i>Johnston</i> .
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Esperia.

Esperia tunicata, <i>Schmidt</i> .	Esperia serratohamata, n. sp.
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Hymedesmina.

Hymedesmia stellivarians, n. sp.	Hymedesmia spinatostellifera, n. sp.
— Moorei, n. sp.	
— capitatostellifera, n. sp.	— trigonostellata, n. sp.

Suberitida.

Suberites vestigium, n. sp.	Suberites angulatus, <i>Carter</i> .
— fistulatus, n. sp.	

Placospongida.

Placospongia melobesioides, *Gray*.

Eccælonida.

Thoosa socialis, n. sp.	Samus (Pachastrella) parasiticus, <i>Crtr.</i>
Dotona pulchella, n. sp.	— complicatus, n. sp. Seychelles.
Alectona Higgini, n. sp.	
Samus anonymus, <i>Gray</i> .	
— simplex, n. sp.	

Geodina.

Geodia perarmata, <i>Bk.</i>	Geodia globostellifera, n. sp.
— areolata, n. sp.	Stelletta euastrum, <i>Schmidt</i> .
— ramodigitata, n. sp.	

Stelletina.

Stelletta tethyopsis, n. sp.
Tisiphonia nana, n. sp.

Tisiphonia (prov.) *annulata*, n. sp.
 — (prov.) *penetrans*, n. sp.

Lithistina.

Corallistes aculeata, n. sp.
 — *verrucosa*, n. sp.
 — *elegantissima*, n. sp.
Discodermia papillata, n. sp.

Discodermia aspera, n. sp.
 — *spinispirulifera*, n. sp.
 — *lævidiscus*, n. sp.

Ord. viii. CALCAREA.

Gen. Leucortis indica, *Häckel*. Imperfect.

SPICULES OF UNKNOWN SPONGES.

HYDROIDA.

Hydradendrium spinosum, nov. gen. et sp.

ACTINOZOA.

Alcyonaria.

Rhizoxenia, *Ehr.*, ? sp.
Spongodes, *Lesson*, ? sp.

Tubipora reptans, n. sp.

POLYZOA.

A great variety of species undetermined.

TUNICATA.

SYNASCIDLÆ, Giard.

Tribe i. *Didemnidae* (with spicules).

Leptoclinum, *Milne-Edwards*. White, incrusting.

GASTEROPODA.

Siliquaria anguina.

Type specimens of all the above organisms, dry and mounted in Canada balsam respectively, may be found in the Liverpool Free Museum, under the designation of "Manaar Collection of 1879, presented by Captain H. Cawne Warren."

EXPLANATION OF THE PLATES.

N.B. To avoid repetition, the measurements are to be considered parts of an inch throughout.

If the *scale* is not given in figures, the following indications should be remembered:—

"Sc. A" means 1-24th to 1-1800th inch.

"Sc. B" means 1-24th to 1-6000th.

"Sc. C" means 1-12th to 1-6000th.

"Sc. D" means 1-48th to 1-1800th.

Where the spicule is fusiform and perhaps curved, a trapezoidal figure has often been given to it for convenience in delineation, although the proportions are maintained; the detail otherwise must be sought for in the letterpress.

Dotted lines and dots are generally intended to represent spination.

PLATE IV.

- Fig. 1. *Dictyocylindrus manaarensis*, n. sp., nat. size: *a*, *b*, *c*, *d*, linear spicules; *e*, tricurvate; *f*, equianchorate (Sc. A); *g*, more magnified view of *e* and *f*.
- Fig. 2. *D. sessilis*, n. sp., nat. size: *a*, *b*, *c*, linear spicules (Sc. A); *d*, more magnified view of *c*.
- Fig. 3. *Microciona bulboretorta*, n. sp., spiculation of: *a*, *b*, *c*, *d*, linear spicules (Sc. A); *e*, more magnified view of *d*.
- Fig. 4. *M. quadriradiata*, n. sp., spiculation of: *a*, *b*, linear spicules; *c*, quadriradiate (Sc. A); *d*, more magnified view of *c*.
- Fig. 5. *M. quinquerradiata*, n. sp., spiculation of: *a*, *b*, *c*, linear spicules; *d*, quinquerradiate (Sc. A); *e*, more magnified view of *d*.
- Fig. 6. *M. curvispiculifera*, n. sp., spiculation of: *a*, *b*, linear spicules; *c*, curvilinear spicule (Sc. A); *d*, more magnified view of *c*.
- Fig. 7. *M. fascispiculifera*, n. sp., spiculation of: *a*, *b*, *c*, linear spicules; *d* is *c* fasciculated (Sc. A); *e*, more magnified view of *b*; *f*, bihamate (Sc. B); *g*, large spicules and fasciculi of *c*, *in situ* (diagram).
- Fig. 8. *Hymerhaphia unispiculum*, n. sp.: one form of spicule only (Sc. A).
- Fig. 9. *H. eruca*, n. sp., spiculation of: *a*, erect linear spicule; *b*, caterpillar-like spicule; *c*, the same, but early stage, resembling the contort spicule of *Hymerhaphia vermiculata*, Bk. (Sc. A).
- Fig. 10. *Hymedesmia stellivarians*, n. sp., spiculation of: *a*, linear spicule (Sc. A); *b*, stellate (Sc. B); *c*, *d*, *e*, various forms of ray, more magnified (diagram).
- Fig. 11. *H. Moorei*, n. sp., spiculation of: *a*, linear spicule (Sc. A); *b*, stellate (Sc. B); *a*, ray, more magnified.
- Fig. 12. *H. capitastellifera*, n. sp., spiculation of: *a*, linear spicule (Sc. A); *b*, stellate (Sc. B); *c*, ray more magnified.
- Fig. 13. *H. spinastellifera*, n. sp., spiculation of: *a*, linear spicule; *b*, different forms of head (Sc. A); *c*, stellate (Sc. B); *d*, ray, more magnified.
- Fig. 14. *H. trigonostellata*, n. sp., spiculation of: *a*, *b*, linear spicules (sc. 1-12th to 1-1800th); *c*, *d*, stellates (Sc. C).
- Fig. 15. *Microciona affinis*, n. sp.: equianchorate, to show hook-like appearance of central arm (Sc. C).

PLATE V.

- Fig. 16. *Reniera* ? sp., white, spicule of (Sc. A).
- Fig. 17. *Reniera* ? sp., yellow, spicule of (Sc. A).
- Fig. 18. *Reniera* ? sp., dark brown, spicule of (Sc. A).
- Fig. 19. *Halichondria aceratospiculum*, n. sp., spiculation of: *a*, linear, acerate, spined; *b*, linear, acerate, smooth, inflated in the centre; *c*, bihamate; *d*, equianchorate (Sc. B).
- Fig. 20. *Esperia serratohamata*, n. sp., spiculation of: *a*, linear spicule; *b*, serrated hamate; *c*, tricurvate; *d*, inequianchorate (Sc. B).
- Fig. 21. *Suberites vestigium*, n. sp., spicule of (sc. 1-12th to 1-1800th).
- Fig. 22. *S. fistulatus*, n. sp., spiculation of: *a*, linear spicule (sc. 1-12th to 1-1800th); *b*, equianchorate, lateral and front views (Sc. B).

- Fig. 23.* *Thoosa socialis*, n. sp., spiculation of : *a*, sceptriform spicule ; *b*, compressed globular spicule (Sc. C).
- Fig. 24.* *Dotona pulchella*, n. sp., spiculation of : *a*, chief spicule ; *b*, fine hair-like acute ; *c*, flesh-spicule (Sc. C) ; *d*, portion of *a*, more magnified, to show by the dotted faint line on the opposite side that the apparent annulations form part of a *spire*.
- Fig. 25.* *Alectona Higgini*, n. sp., spiculation of : *a*, chief spicule ; *b*, fine hair-like acerate, subtricurvate ; *c*, flesh-spicule (Sc. C).
- Fig. 26.* *Samus simplex*, n. sp., spiculation of : *a*, lateral view of main spicule ; *b*, horizontal view of head (Sc. A) ; *c*, flesh-spicule (Sc. C).
- Fig. 27.* *S. complicatus*, n. sp. : main spicule, horizontal view, upperside (Sc. A).
- Fig. 28.* *Tisiphonia annulata*, n. sp., spiculation of : *a*, annulated quadri-radiate ; *b*, linear acerate (Sc. A) ; *c*, flesh-spicule spinispirulate (Sc. C) ; *d*, portion of *a*, more magnified.
- Fig. 29.* Verticillately spined cylindrical spicule of unknown sponge abundant in excavated cavities of the Melobesian nodules (Sc. B).
- Fig. 30.* Pin-like spicule with spinated extremities and head turned to one side, of unknown sponge found in similar cavities of the Melobesian nodules (Sc. A).
- Fig. 31.* *Geodia ramodigitata*, n. sp., nat. size : *a*, zone-spicule ; *b*, body-spicule ; *c*, fork and anchor ; *d*, siliceous globules, round and oval respectively ; *e*, stellates of both localities, viz. external and internal (Sc. D) ; *f*, stellates, more magnified.

PLATE VI.

- Fig. 32.* *G. perarmata*, Bk. Section through the centre, nat. size : *a*, dermal layer ; *b*, interval between the dermal layer and petrous crust ; *c*, petrous crust ; *d*, body or interior.
- Fig. 33.* The same, spiculation of : *a*, zone-spicule ; *b*, body-spicule ; *c*, fork and anchor ; *d*, siliceous globules, round and oval ; *e*, external and internal stellates (Sc. D) ; *f*, more magnified views of *e*, respectively.
- Fig. 34.* The same. Dermal layer viewed from within : *a*, head of zone-spicule ; *b*, pores in dermal layer, with stellates in the lower half ; the latter represented by the dots (diagram).
- Fig. 35.* The same. Vertical section of dermal layer, subdermal chamber, and adjoining part of petrous crust : *a*, dermal layer charged with stellates ; *b*, subdermal chamber or interval ; *c*, part of petrous crust ; *d d*, heads and adjoining shafts of zone-spicules (diagram).
- Fig. 36.* *G. areolata*, n. sp., spiculation of : *a*, zone-spicule ; *b*, body-spicule ; *c*, fork and anchor ; *d*, siliceous globules, round and oval ; *e*, external and internal stellates ; *g*, dermal acerate (Sc. D) ; *f*, stellates, more magnified.
- Fig. 37.* The same, portion of surface, more magnified, to show areolation and position of dermal acerates (diagram).
- Fig. 38.* *G. globostellata*, n. sp., spiculation of : *a*, zone-spicule ; *b*, body-spicule ; *c*, fork (no anchor seen) ; *d*, siliceous globules, round and oval ; *e*, globostellate ; *f*, external and internal stellates (Sc. D) ; *g*, more magnified view of *e* ; *h*, more magnified views of *f*.
- Fig. 39.* *Stelletta tethyopsis*, n. sp., torn off from the base (nat. size).
- Fig. 40.* The same, spiculation of : *a a*, zone-spicule ; *b b*, body-spicule ;

c, fork and anchor; *d*, occasional form of zone-spicule; *e*, external stellate; *f*, internal stellate (Sc. D). The dotted lines at the bottom of *a a* and *b b*, respectively, are to show that they are continuations of the same spicules, which, upon this scale, are too long for the Plate.

PLATE VII.

- Fig. 41.* *Stelletta cuastrum*, Sdt., parasitic on a group of *Siliquaria anguina*: *a a*, mouths of the *Siliquariæ* (nat. size); *b*, zone-spicule; *c*, body-spicule; *d*, siliceous disk; *e*, minute acerate flesh-spicule; *f*, minute stellate flesh-spicule (Sc. D); *g*, more magnified views of *d*, *e*, and *f*, respectively (sc. 1-48th to 1-6000th); *h*, still more magnified view of acerate flesh-spicule, to show that it is microspined and inflated in the centre; *i*, more magnified view of ray of stellate, to show that it is microspined; *k*, more magnified view of portion of disk, to show form and position of stelliform points on surface; *l*, still more magnified views of point, lateral and direct, respectively.
- Fig. 42.* The same, Australian specimen: *a a a*, vents; *b b*, pores in the crust (nat. size); *c*, spined stellate (quadriradiate) (Sc. B).
- Fig. 43.* *Tisiphonia nana*, n. sp.: *a*, zone-spicule, viewed from above, as seen *in situ*; *b*, the same, lateral view (observe the extremely short shaft); *c*, body-spicule; *d*, acerate flesh-spicule and stellate (Sc. D); *e*, more magnified view of the same.
- Fig. 44.* *T. penetrans*, n. sp.: *a*, body-spicule; *b*, acerate flesh-spicule and stellate (Sc. A); *c*, more magnified view of stellate (Sc. C); *d*, still more magnified view of ray of same.
- Fig. 45.* *Corallistes aculeata*, n. sp. Oblique view of surface, showing spikes (Sc. about A): *a*, spike-spicule, lateral view; *b*, base of the spike, broken off, viewed from above (Sc. B). (Diagrams.)
- Fig. 46.* *C. verrucosa*, n. sp. Oblique view of surface, showing verrucous cones (Sc. about A): *a*, verrucous cone-spicule, lateral view; *b*, base of the cone, viewed from above (Sc. B). (Diagrams.)
- Fig. 47.* *C. elegantissima*, n. sp., spicule of (sc. 1-48th to 1-6000th).

PLATE VIII.

- Fig. 48.* *Discodermia papillata*, n. sp. Portion of surface viewed from above: *a*, disks covered with minute, fusiform, bacillar flesh-spicules; *b*, the same without the flesh-spicule; *c*, subjacent spiculation (Sc. about D); *d*, five figures to show the transformation into the surface-spiculation seen at *c*; *e*, shaft of disk; *f*, papillæ on disk; *g*, fully formed papillæ, more magnified; *h*, fusiform bacillar flesh-spicule, much magnified; *i*, ultimate form of spicule of the interior; *k k k*, interlocking of the ends of the branches with those of neighbouring spicules; *l*, characteristic form of "interlocking," much magnified. (Diagrams.)
- Fig. 49.* *D. aspera*, n. sp. Portion of surface viewed from above: *a*, disks covered with minute, acerate, curved, fusiform flesh-spicules; *b*, the same without the flesh-spicule (Sc. about D); *c*, more magnified view of disk, showing denticulated margin and papillæ; *d*, acerate flesh-spicule (Sc. D); *e*, the same, more magnified; *f*, more advanced form of disk, in which the papillæ are transformed into spines, more or less divided; *g*, four diagrams, showing the transformation of the papillæ into the spinous condition; *h*, ultimate form of spicule of the interior;

i, characteristic form of the interlocking end of the branch, much magnified. (Diagrams.)

Fig. 50. *D. spinispirulifera*, n. sp. Portion of surface viewed from above: *a*, disks covered with acerate, curved, fusiform, and spinispirulate flesh-spicules; *b*, the same without the flesh-spicules; *c*, subsurface spiculation (Sc. A); *d*, four figures showing the gradual transformation of the disk into the subsurface spiculation *c*; *e*, magnified view of the acerate flesh-spicule; *f*, the same of the spinispirula; *g*, ultimate form of spicule of the interior; *h*, characteristic form of interlocking extremity of branch, much magnified. (Diagrams.)

Fig. 51. *D. lævidiscus*, n. sp. Portion of surface viewed from above: *a*, disks covered with the acerate, curved, fusiform flesh-spicule; *b*, the same without the flesh-spicule (Sc. about D); *c*, upper surface of disk, more magnified, to show its smoothness, faint, concentric, circular lines and depression; *d*, under surface of the same, to show spine or shaft; *e*, more advanced form of same, showing subdenticulated border; *f*, acerate flesh-spicule (Sc. D); *g*, the same, more magnified; *h h*, ultimate form of spicule of interior; *i*, union of branches by simple apposition.

XVII.—Note on the Genus *Heteropora*.

By ARTHUR WM. WATERS, F.G.S.

I HAVE noticed lately in several reviews an error with regard to *Heteropora* to which it seems advisable to call attention lest it creep into the literature of the subject. The confusion is perhaps the most glaring in a review of Nicholson's 'Tabulate Corals,' in 'Nature' (March 25th)—a review which has a certain family likeness to a notice of the same book which appeared in the 'Academy' some time before, signed by Mr. Moseley, where the same mistake occurs.

In the notice in 'Nature' the reviewer says, "Some, as *Heteropora*, are, according to the late researches of Mr. Busk, of Bryozoan affinity." This shows that the points raised by Mr. Busk have not been appreciated; for the genus *Heteropora* was created by Blainville for some cretaceous fossil Bryozoa, and the genus, as palæontologists are well aware, was very abundant in the Jurassic, Cretaceous, and Tertiary periods, occurring frequently in the English Crag; but no living forms had been described until I drew attention to two living species, from Japan and Australia, in a paper with plate, "On the Occurrence of Recent *Heteropora*," in the Journ. of the Roy. Micro. Soc., May 14, 1879, in which I alluded to the minute perforations of the calcareous walls. This is of interest as being a somewhat similar structure to that of some of the so-called tabulate corals, but is not, as some seem to